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PORUGUESE PRODUCTION AND DISTRIBUTION OF ELECTRIC POWER, 1951 - 1952

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The following report on progress in the expansion of Portugal's electric power production and distribution system was compiled from news items and annual reports of various electric power companies appearing in Portuguese newspapers and periodicals from 13 February to 18 October 1952. For earlier information, on developments from 17 April to 17 November 1951 [redacted]

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General Situation

The following figures on Portuguese electric power production were provided by the electrical producers section of the Associacao Industrial Portuguesa (Portuguese Industrial Association). The figures refer only to member firms, but since these firms produce about 90 percent of Portugal's total electricity, the figures may be applied to the country as a whole.

Production of hydroelectric power in Portugal in 1950 was 392.5 million kilowatt-hours; of thermal electric power, 441.1 million. In 1951, production of hydroelectric power rose to 768.2 million, an increase of 96 percent over 1950, while that of thermal electric power fell to 178 million, a drop of 60 percent.

Installed power in hydroelectric plants reached 345.7 megawatts, as compared with 138.6 megawatts in 1950, an increase of 207.1 megawatts or 150 percent. This increase is traceable to: (a) the opening of the new plants of Castelo do Bode, with 93 megawatts, Vila Nova with 43.2, Pernide [probably a misprint for Penide] with 1.8, Belver with 16.2, Vale do Gaio with one, and Pego do Altar with 2, a total of 157.2 megawatts in new installed capacity; and (b) the expansion of existing plants, such as Lindoso, with 29.6 megawatts, the Serra da Estrela system with 14.8, and Pracana with 6.6, a total of 51 megawatts. The capacity of the Rio Ave and Santa Luzia system was corrected downward by 1.1 megawatts to take into account the power under average head.

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A total of 30 power plants with an average power of 10.5 megawatts operated in 1951, as compared with 24 plants with an average power of 5.8 megawatts in 1950. There were no changes in existing thermal electric plants. The number remained at 11, with a total installed capacity of 134.5 megawatts. The plants are getting old, however, and require special care in their maintenance and operation. The whole thermal electric situation could benefit from a thorough survey.(1)

The annual report of the CNE (Companhia Nacional de Electricidade, National Electricity Company) for 1951 took note of important events in Portuguese electric power production. The power plants of Castelo do Bode, Vila Nova, and Pracana were opened. The first machines went into operation at Belver. Electric power was transmitted in Portugal for the first time at 150 kilovolts. The first two big electrochemical industries started experimental operations [probably the two ammonium sulfate fertilizer plants of Amoniaco Portugues (Portuguese Ammonia) and the Uniao Fabril do Azoto (Nitrogen Producing Union)]. The Repartidor Nacional de Cargas (National Power Pool) was created. Total electric power production in Portugal exceeded one billion kilowatt-hours for the first time, reaching 1,036,000,000, a per-capita consumption of 122 kilowatt-hours; hydroelectric power production exceeded thermal electric for the first time, being 75 percent of the total.(2)

The Repartidor Nacional de Cargas, comprising the most important electric power companies in Portugal and representing about 90 percent of total electric power production (3), provided the following statistics on production and consumption of Portuguese electricity for the first 8 months of 1951 and 1952 (in kilowatt-hours).

| Month | <u>Production</u> | | <u>Consumption</u> | |
|-------|-------------------|------------------|--------------------|-------------------|
| | Hydroelectric | Thermal Electric | 1952 | 1951 |
| Jan | 90,796,155 | 7,368,670 | 82,524,280 | 69,472,191 |
| Feb | 92,059,077 | 7,961,280 | 87,396,960 | 64,608,275 |
| Mar | 91,440,359 | 7,039,240 | 83,821,526 | 65,115,730 |
| Apr | 96,679,797 | 3,120,350 | 88,104,257 | 60,903,899 (4, 5) |
| May | 102,586,956 | 5,640,280 | 94,388,962 | 60,097,603 |
| June | 90,732,665 | 5,936,000 | 84,744,167 | 59,460,842 |
| July | 95,715,621 | 7,238,300 | 86,732,020 | 64,039,190 |
| Aug | 93,713,936 | 7,017,360 | 83,367,393 | 61,109,730 (5) |

Hidro-Electrica do Zezere

The 1951 annual report of Hidro-Electrica do Zezere, S.A R.L., (Zezere Hydroelectric, Inc), Avenida Sidonio Pais 24, Lisbon, stated that the Castelo do Bode dam has been working uninterruptedly since its inauguration on 21 January 1951. Total production in 1951 was 207,777,790 kilowatt-hours, of which 206,124,000 were sold. Losses and the plant's own consumption reached 1,653,790 kilowatt-hours, or 0.8 percent of total production. Minimum monthly production in 1951 was 13 million kilowatt-hours in February, and the maximum was 29 million in December.(3) A later advertisement of the company stated that total production up to 15 May 1952 was 317.5 million kilowatt-hours; installed capacity is 186,000 kilowatts.(4)

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The company's annual report continued: Although rainfall was abundant in February and March 1951, it was not adequate in April and May to maintain a high water level in the reservoir. For this reason, the supply of electricity to Lisbon had to be supplemented by other power plants. This was done under terms of a three-way contract with the CNE and the Companhias Reunidas Gas e Electricidade (United Gas and Electricity Companies). The Tejo thermal electric plant worked in conjunction with the Castelo do Bode hydroelectric plant from the inauguration of the latter until the latter's second group was put in service in May, when the Hidro-Electrica do Zezere began to supply all of Lisbon's electricity. During a low-water period from mid-September to the beginning of November, this was again supplemented by the Tejo plant and also by the Vila Nova hydroelectric plant through the Aguas Santas-Zezere transmission line of the CNE.

The report stated that, although Castelo do Bode's second generator group went into service on schedule in May 1951, after the necessary trials, operation of the third group had been held up by difficulties in installing the generator's spherical valve. It was hoped that the group could go into operation within a few days.

Installation of the spillway floodgates was completed in the course of the year.

The report pointed out that on the two occasions when the water level at the dam was high -- the first in the spring and the second in November -- the behavior of the dam and ground was found to be perfectly elastic, as is to be desired in structures of this nature.(3)

After heavy rainfall, the water level in the Castelo do Bode lake rose on 10 April 1952 to 121 meters, the top level established by the engineers.(6)

With regard to the Cabril project, it was stated in the annual report that the necessary financial arrangements had been authorized, the work yard was being set up, the upstream cofferdam was in place, and the water was being diverted through the derivation tunnel. In spite of setbacks to the unwatering caused by early floods in November, it was expected that concrete pouring for the dam itself could begin in May 1952. Target date for the opening of the new power plant is the end of 1954. Main construction on the dam is entrusted to an association of the firms Moniz da Maia, Duarte & Vaz Guedes, Ltda., and S.A. Conrad Zschokke [sic], who built Castelo do Bode. Electrical installations are to be supplied by the same English group which equipped Castelo do Bode.

The report also cited the entry in service of the Zezere-Oporto transmission line and the second Zezere-Lisbon line of the CNE.(3)

Details of the Cabril power project were given in an advertisement as follows:

Hydrology: area of hydrographic basin, 2,340 square kilometers; average yearly rainfall, 1,350 millimeters, average yearly flow, 47 cubic meters per second.

Energy and Capacity: average yearly production, 200 million kilowatt-hours, increase of Castelo do Bode's production, 50 million kilowatt-hours; permanent capacity, 25,000 kilowatts, capacity to be installed, 108,000 kilowatts.

Dam: double curvature, arched type, height, 125 meters, radius at crest, 158 meters, volume of concrete, 320,000 cubic meters.

Spillways (evacuador de cheias): two tunnel spillways with 6.5-meter diameter each; maximum flow, 1,130 cubic meters each.

Powerhouses: two main turbogenerator groups of 73,000 horsepower and 15,500 volts fed by conduits 4 meters in diameter; one auxiliary turbogenerator group of 1,300 horsepower and 400 volts.(4)

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~~CONFIDENTIAL~~Hidro-Electrica do Cavado

The main office of Hidro-Electrica do Cavado, S.A.R.L., (Cavado Hydroelectric, Inc) is located in Oporto at Rua Sa da Bandeira 567, with an agency in Lisbon at Avenida Sidonio Pais 14. (7) Fernao Manuel de Ornelas Goncalves is chairman of the board.

The company's Venda Nova dam and Vila Nova hydroelectric plant, inaugurated 9 June 1951, produced 68,906,100 kilowatt-hours up to the end of that year. (8) Of this, Amoniaco Portugues consumed 1.8 million. Production in 1952, up to the end of April, had reached almost 52 million kilowatt-hours, including some days on which production passed one million. Of the 52 million kilowatt-hours, Amoniaco Portugues consumed 23 million, and its consumption as of May 1952 was running at 300,000 a day.

Construction at the Saimonde dam was well advanced. The first generator group was expected to be ready for service within one year. The transformer substation is to be located on a 1,500-square-meter platform on the left bank near the dam. (9) Installed capacity is to be 38,000 kilowatts and annual production 100 million kilowatt-hours. (8) The power plant, located near the dam about 50 meters below the level of the river bed at that point, is to have two generator groups of 25,000 kilovolt-amperes each. All auxiliary installations, offices, etc., are to be located aboveground beside the transformer substation. The dam is on the Cavado River about 200 meters upstream from the confluence of the Mau River, a small branch entering on the left. The access road to the dam and substation is 7,600 meters long. (10)

Preliminary plans for the Canicada dam were completed in October 1951. By February 1952, an access road had been laid to the dam site, bidding was ending not only for the construction contract but also for supplying electro-mechanical equipment; and ground surveys were under way for the dam foundation. (10) By May 1952, work had already begun on the temporary cutoff dam at the upstream end of the diversion gallery cut in the left bank of the Cavado. (9) The permanent dam itself is to be 72 meters high and will impound 115 million cubic meters of water. Total length of head and tail galleries is to be 7,600 meters, maximum head, 117 meters. (9, 10, 11) Maximum derivable flow is 65 cubic meters per second. (10, 11) The power plant is located underground next to the dam, with the turbines at a level of 44 meters below the river bed. (11) The access shaft to the power plant will be almost twice as high as the Torre dos Clerigos in Oporto and will contain an elevator with a 2,000-kilogram maximum capacity. (9) Installed capacity under average head is to be 45,000 kilowatts; yearly production of permanent energy is to be 155 million kilowatt-hours, increasing to 190 million when the Paradela dam is put in service. (9, 11) The concrete to be used in the Canicada project would load a train 20 kilometers long, made up of 1,500 cars. The dam and resultant storage lake will inundate the town of Vilar da Veiga, causing a loss of 700 carloads in corn alone, as well as the loss of the wine and olive oil produced there. The Concelho (County) de Terras do Bouro will thus have to be compensated for this loss of resources. (9)

Hidro-Electrica do Alto Alentejo

The General Assembly of Hidro-Electrica do Alto Alentejo (Alto Alentejo Hydroelectric) met on 26 March 1952. The company's 1951 annual report announced completion of all work on the Fracana hydroelectric development, where production had already reached 24 million kilowatt-hours. The report also stated that machinery installations were being completed at the Belver power plant and three turbogenerator groups were already operating on an experimental basis. It was hoped that installation of the fourth and final group would be completed in a few days so that it, too, could begin experimental operations.

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Power production at the Pracana plant had not met expectations, it was explained, because there was a delay in installing the flooagate, making it impossible for the water to attain maximum storage level.(12)

Empresa Hidroelectrica da Serra da Estrela

The 1951 annual report of the Empresa Hidroelectrica da Serra da Estrela, S.A.R.L., (Serra da Estrela Hydroelectric Enterprise, Inc) -- main office, Avenida Sidonio Pais 26, Lisbon -- reported the entry in service of the new 9,000-horsepower group of the Ponte de Jugais power plant, where a new 4,200-horsepower turbine was also being installed. Extensive remodeling work had been completed at this plant.

In the Sabugueiro power plant, a new 9,000-horsepower group was being installed. Work was to be completed by the end of 1952, putting the plant in full operating condition.

The Seia substation began full service, connecting the Sabugueiro, Ponte de Jugais, and Vila Cova power plants through new lines and concentrating all the company's distribution services. In addition to other work on interplant connecting lines, the 40,000-volt Unhais-Covilha section was completely replaced. It was hoped that reconstruction of the whole Covilha line would be completed in 1952.

The report also stated that little work had been done on dams, not for lack of studies and preparation but because funds had not been allocated by the proper authorities.

Production reached 67,602,480 kilowatt-hours in 1951 and was expected to continue rising in 1952.(3,13)

CNE

Since its founding in 1947, the CNE has put up 614 kilometers of 150-kilovolt lines and four modern transformer substations, carrying out its mission well ahead of schedule. In 1951, the CNE transmitted over its then uncompleted installations about 264 million kilowatt-hours of hydroelectric power. The lines and substations thus far built permit the interconnection of the country's principal hydroelectric systems. This is expected to do much to ease seasonal restrictions of power in some areas. The systems connected to the CNE at present are the Hidro-Electrica do Cavado, Uniao Electrica Portuguesa (Portuguese Electric Union), Companhia Electrica das Beiras (Beiras Electric Company), Hidro-Electrica do Alto Alentejo, and Companhia Hidro-Electrica do Norte de Portugal (Northern Portugal Hydroelectric Company). Other hydroelectric projects now under construction or being studied are to be connected in due course. Certain base industries are to be supplied with hydroelectric power by direct connection.(11)

The CNE annual report for 1951 stated that the first Zezere-Lisbon transmission line, rated at 150 kilovolts, went into full operation on 29 January 1951. On 19 June, regular transmission began over the Cavado-Oporto line. On 17 October, the Zezere-Oporto interconnection line was put in service, enabling Lisbon to supplement its supply with electricity from the Vila Nova power plant, almost 400 kilometers away. The second Zezere-Lisbon line, put in service experimentally on 12 December 1951, went into full operation in 1952.

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The following figures, given in the report, are a breakdown of the power received by the CNE from producers and supplied in turn to local distributors (in kilowatt-hours):

Electricity received from:

| | |
|----------------------------------|-------------|
| Hidro-Electrica do Zezere | 206,154,117 |
| Hidro-Electrica do Cavado | 63,337,603 |
| Companhia Electrica das Beiras | 4,597,850 |
| Uniao Electrica Portuguesa | 48,050 |
| Hidro-Electrica do Alto Alentejo | 23,500 |
| Total | 274,161,120 |

Electricity supplied to:

| | |
|---|-------------|
| Companhias Reunidas Gas e Electricidade | 203,385,000 |
| Companhias Hidro-Electrica do Norte de Portugal | 26,988,950 |
| Uniao Electrica Portuguesa | 23,995,932 |
| Hidro-Electrica do Alto Alentejo | 7,391,000 |
| Companhia Electrica das Beiras | 648,850 |
| Amoniaco Portugues | 1,671,130 |
| Total supplied | 264,080,962 |
| Auxiliary services | 70,998 |
| Losses | 10,009,260 |
| Total | 274,161,120 |

According to the report, this turnover is only about half of what the company's normal minimum should be. Hope was expressed that the power to be carried in 1952 would not be less than 400 million kilowatt-hours, and it was held probable that within a few years more than half of Portugal's total consumption would pass through the CNE grid.

The report mentioned that, under the terms of Decree No 38,386 of 28 February 1951, which set up the Repartidor Nacional de Cargas, the CNE has a permanent seat on the Directive Commission and exercises the function of acting Executive Body.

With regard to the company's construction program, the report stated that the Lisbon-Setubal transmission line and the Setubal substation were in advanced construction and were to go in service by mid-1952. There were still no plans to extend a line farther southward, as there was still no distributor in the south capable of handling power at 60 kilovolts in the Beja region.

Plans are being completed, according to the report, for the line which will connect the future Cabril power plant of the Hidro-Electrica do Zezere to the Zezere substation of the CNE. Construction of the line is scheduled for 1953. Anticipating, likewise, the completion of the Canicada power plant of the Hidro-Electrica do Cavado, the CNE expected to start work in 1952 on plans for a second Cavado-Oporto line to be built, it was presumed, in 1954.

As stated in the CNE's previous annual report, the Estarreja plant of Amoniaco Portugues has been supplied with electricity by a provisional branch line from the Zezere-Oporto trunk, operating temporarily at 60 kilovolts. A direct line from Oporto to Estarreja was nearly finished and was ready for use in March 1952, freeing the Zezere-Oporto line to resume its normal function as a 150-kilovolt North-South transmission trunk.(14)

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An advertisement of the Agencia Geral de Material Electrica, Lda., (General Agency for Electrical Material, Ltd) announced the imminent arrival in Portugal of another 25,000-kilovolt-ampere transformer from the Alsthom Als-Thom, administration at Paris; factory at Belfort/ works in France to be used in the 150-kilovolt Setubal substation of the CNE. It was expected that this unit would be put in service by midsummer 1952.(15)

The CNE's Sacavem substation in Lisbon was put in operation on 12 July 1952. Its cost was 52.1 million escudos.(16,17,18)

Miscellaneous

The 1951 annual report of General Electric Portuguesa, S.A.R.L., (Portuguese General Electric, Inc), Rua do Norte 5, Lisbon, mentioned its poor business results for the year but pointed out its continued technical success. In August 1951, the report noted, a 40,000-kilovolt-ampere generator group was put in service at the Lindoso power plant and has since been operating perfectly.(14)

The Directorate-General of Hydraulic Services has been authorized to enter into contract with the firm Duran, Garcia & Cia for the supply and installation of the electromechanical equipment of the Campilhas hydroelectric plant, in the amount of 3 million escudos.(19,20) Of this amount, 900,000 escudos are to be paid in 1952 and 2.1 million in 1953.(20)

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1. Lisbon, Jornal do Comercio, 17 Jun 52
2. Ibid., 27 Mar 52
3. Ibid., 5 Apr 52
4. Oporto, A Industria do Norte, Nos 387-388, Mar/Apr 52
5. Ibid., No 393, Sep 52
6. Lisbon, Diario da Manha, 12 Apr 52
7. Jornal do Comercio, 8 May 52
8. Diario da Manha, 13 Feb 52
9. Jornal do Comercio, 30 May 52
10. Ibid., 16 Feb 52
11. Diario da Manha, 24 Feb 52
12. Ibid., 27 Mar 52
13. Ibid., 30 Mar 52
14. Jornal do Comercio, 6 Apr 52
15. Ibid., 10 Apr 52
16. Ibid., 14 Jul 52
17. Diario da Manha, 13 Jul 52

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- 18. Lisbon, Noticias de Portugal, 19 Jul 52
- 19. Jornal do Comercio, 25 Jun 52
- 20. Diario da Manha, 21 Jun 52

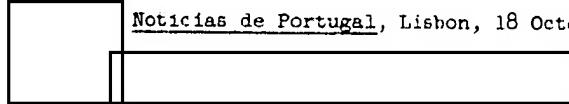


1. Location: Portugal, Zezere River, Castelo do Bode Dam

Caption and Description: "Castelo do Bode Dam, Air View." High angle, bright sunlight view, showing lower portion of storage lake, downstream facing of dam with turbine house at base, downstream gorge, and road approaches

Photograph Description: Size, 5-3/8 x 5-5/8 inches; fair, newsprint

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